mate equation between the pressure gradient on the one hand and the combined centrifugal force and deflection force due to rotation on the other. Hence, at these levels, if dp/dn is the maximum horizontal pressure gradient,

$$\frac{dp}{dn} = -\rho V\left(2\,\omega \sin\phi + \frac{V}{R}\tan\phi\right), \text{ approximately,}$$

in which ρ is the density of the air at the level under consideration, V the wind velocity, ω the angular velocity of rotation of the earth, ϕ the latitude, and R the radius of the earth.

A little calculation shows that the second term in the parentheses is always small, except in very high latitudes, in comparison with the first. Thus for a west wind moving 22.4 meters per second (50 mis./hr.), at latitude 45°, the first term is about 30 times greater than the second. Hence, under these conditions,

$$\frac{dp}{dn} = -2\,\rho V\omega \sin\phi, \text{ approximately.}$$

But, as just explained, the horizontal pressure gradient, dp/dn, is roughly constant between 5 and 10 kilometers elevation. Hence at any given latitude, ρV, the mass flow, or mass of air crossing unit normal area per unit time, tends to remain constant with change of altitude from 4 or 5 kilometers above sea level up to the isothermal region. In other words, through this region, ρV, at altitude h is equal to $\rho' V'$ at altitude h', nearly. This relation between the density and velocity of the atmosphere at different levels is known as Egnell's law,[8] determined empirically by himself, as also previously by H. H. Clayton,[9] from cloud observations. Obviously ρV has a maximum value at that level at which the horizontal pressure gradient is a maximum, that is, at about 8 kilometers above sea level.

RELATION OF VELOCITY TO ALTITUDE ABOVE 5 KILOMETERS.

Obviously, if the temperature is constant, as for simplicity we may assume it to be,

$$\frac{\rho}{\rho'} = \frac{p}{p'}.$$

But, as already seen, under this condition of constant temperature, through a considerable range of altitude—that is, from below 5 to above 10 kilometers—

$$\frac{p}{p'} = \frac{h'}{h}, \text{ roughly.}$$

Hence,

$$\frac{\rho}{\rho'} = \frac{h'}{h}, \text{ roughly.}$$

But, as explained above

$$\rho V = \rho' V', \text{ nearly,}$$

therefore,

$$\frac{V}{V'} = \frac{h}{h'}, \text{ approximately,}$$

or the velocity of the wind through the levels in question is roughly proportional to the altitude.

Above the isothermal level over the regions between the thermal equator and latitude 50° or 60° the horizontal temperature gradient decreases, and presently even reverses, with increase of elevation, as shown by figure 2, and therefore the corresponding pressure gradient also decreases as shown by figure 3. Hence the mass flow, ρV, likewise decreases with elevation above this critical level. Further, the decrease of the horizontal pressure gradient, and, consequently, of ρV, with altitude in the stratosphere appears usually to be more rapid than that of the density alone, from which it follows that the wind velocity generally must have its maximum value at or below the isothermal level.

[8] Comptes rendus, 1903, 136:360.
[9] *Clayton* in Amer. met'l. jour., Boston, August 1893, 10:177.

(5)

SOME RESEARCHES IN THE FAR EASTERN SEASONAL CORRELATIONS.

(FIRST NOTE.)

By T. OKADA.

[*Reprinted from* Journal of the Meteorological Society of Japan, December, 1915, 34, No. 12.]

I.

1. *Introduction.*—It is a well-known fact that for the Far East the great pressure maximum over Siberia and the deep barometric minimum to the south of the Aleutian Islands are the prominent centers of action of the atmosphere in winter, while the great Pacific anticyclone and the continental low area are their summer counterparts. The weather anomaly of the Far East, especially of this country [Japan] is closely and causally related to the occasional change in the positions and intensities of these atmospheric centers.

In 1910 the author published a short paper containing a number of examples of simultaneous correlations in air temperature and rainfall at some places in the Far East. The present note will give a few examples of the remarkable interdependence existing between the pulsations of the Siberian anticyclonic system in winter and the air temperature anomaly of the east coast of Japan in the following summer. The investigation of this correlation may be of some interest for the solution of the fascinating problem of the climatic forecast which aims at predicting the general character of a coming season months in advance.

2. *Method and data.*—As an index of the intensity of the center of action the absolute value of the barometric pressure at a locality situated in the center is not a suitable one. The true measure of the intensity is the barometric gradient. The barometric readings at the Irkutsk Observatory, lying in the heart of the atmospheric center, may be of great service in estimating the intensity of this center. But the great altitude of Irkutsk requires a large correction to be added to reduce its barometric readings to sea level and this greatly reduces the value of those readings as data for the present investigation. In calculating the barometric gradient the most proper material is the pressure data of the meteorological stations lying near sea level. I have therefore used the results of observations taken at the observatories at Zikawei, Nafa, and Izugahara. The geographical coordinates of these observatories are:

Observatory.	Longitude.	Latitude.	Altitude.	Established.
			Meters.	
Zikawei	119° 6′ E.	31° 12′ N.	7.0	1873
Nafa	127° 4′ E.	26° 13′ N.	10.4	1890
Izugahara	129° 16′ E.	34° 12′ N.	9.2	1886

First were computed the differences between the sea-level pressures at Zikawei and Nafa, and those at Zikawei and Izugahara. Since Nafa and Izugahara are equally distant from Zikawei these differences of pressure may be considered as the components of the required pressure gradient. From these components we have computed the resultant gradient at Zikawei by the graphical method.[1] The calculated gradients are not expressed in the customary unit, simply because it is unnecessary to do so for the present investigation.

Table 1 gives the component gradients and their resultant for the mean pressure at Zikawei for March.

TABLE 1.—*Barometric gradient at Zikawei* [2] *for March.*

Year.	Pressure at Zikawei (760+).	Pressure differences.		Barometric gradient.	Azimuth.
		Zikawei—Nafa.	Zikawei—Izugahara.		
	mm.	*mm.*	*mm.*		*N.—°E.*
1891	5.9	3.3	1.8	3.35	121
1892	6.7	5.0	1.7	5.00	134
1893	5.4	2.5	1.0	2.50	130
1894	5.7	3.2	2.4	3.45	109
1895	5.1	1.9	1.1	1.95	120
1896	7.3	4.0	1.1	4.05	138
1897	5.7	3.2	−0.6	3.75	162
1898	6.0	4.3	0.9	4.35	141
1899	6.0	2.3	2.1	2.65	100
1900	5.9	2.5	1.9	2.70	109
1901	7.6	2.1	1.4	2.20	114
1902	3.7	0.6	0.0	0.75	153
1903	3.9	2.2	0.3	2.30	145
1904	5.2	3.8	1.2	3.80	135
1905	6.7	3.7	1.0	3.75	137
1906	6.5	2.3	2.7	3.05	91
1907	6.0	2.9	1.9	3.05	115
1908	7.0	3.2	1.8	3.30	120
1909	6.7	3.7	1.2	3.75	134
1910	5.3	2.5	1.1	2.55	127

Table 2 gives the component gradients and their resultant for the mean pressure at Zikawei for the three months, January to March:

TABLE 2.—*Barometric gradient at Zikawei* [3] *for the period January to March.*

Year.	Pressure at Zikawei (760+).	Pressure differences.		Barometric gradient.	Azimuth.
		Zikawei—Nafa.	Zikawei—Izugahara.		
	mm.	*mm.*	*mm.*		*N.—°E.*
1891	8.2	4.3	2.7	4.4	115
1892	8.0	4.9	2.2	4.9	130
1893	8.3	5.0	2.7	5.1	120
1894	8.0	3.4	2.5	3.6	110
1895	7.1	3.2	2.0	3.3	116
1896	8.7	4.1	2.3	4.2	120
1897	8.1	4.6	1.3	4.6	130
1898	6.9	4.1	1.4	4.1	125
1899	8.0	3.8	2.2	3.9	120
1900	8.9	4.7	2.5	4.8	125
1901	9.2	3.9	3.5	4.4	110
1902	7.7	2.2	1.6	2.3	110
1903	8.3	3.4	2.8	3.8	104
1904	7.9	3.7	1.8	3.8	124
1905	7.1	3.5	2.4	3.7	113
1906	7.4	3.9	2.3	4.0	118
1907	8.2	4.3	2.6	4.4	117
1908	8.9	4.2	2.6	4.3	116
1909	7.9	4.6	2.1	4.7	125
1910	7.3	3.8	2.7	4.0	110

[1] *Okada, T.* On the graphical method for finding the barometric gradient. Jour. met'l. soc. Japan, April, 1909, p. 91.
[2] Pressures at Nafa and Izugahara not reproduced here—C. A. jr.
[3] Pressures at Nafa and Izugahara here omitted—C. A. jr.

The data utilized in the above and following calculations are taken from the Annual Reports of the Central Meteorological Observatory, Tokyo, and Bulletin des Observations de l'Observatoire de Zikawei, Année 1910. All the pressure readings have been corrected for standard gravity and reduced to sea level, using the International Meteorological Tables.

II. AIR TEMPERATURE.

3. *Correlation between March barometric gradient at Zikawei and July–August air temperature on the east coast of Japan.*—In summer the anomaly of weather, especially of air temperature, in northeastern Japan is closely connected with the perturbation in the intensity of the Pacific anticyclone. In July and the early part of August the western margin of the grand barometric maximum extends toward the east coast of Hokkaido and sends cooler air currents to our northeastern provinces, causing a fall of temperature there. From my daily exercise in charting the weather materials sent telegraphically from the various parts of Japan and the continent [Asia] I have incidentally noticed that the summer high barometer over the Pacific is preceded by the lower barometer on the continent in the past colder month. I have tried, therefore, to find the correlation, if any exists, between the barometric height on the continent during the winter and the air temperature on the east coast of Japan in the following summer.

In March the anticyclonic system on the continent is in the declining stage. Hence the barometric gradient for March may serve as an index of the remnant activity of the continental [Asiatic] atmospheric center. After many laborious computations and comparisons I have found there exists a well-established interrelation between March barometric gradient (x) at Zikawei and the mean air temperature (y) for July and August at the stations on the east coast of Japan, as can be seen from Table 3. On the east coast of Japan we have three meteorological observatories having long and homogeneous series of observations. Their names and positions are:

Observatory.	Longitude.	Latitude.	Altitude.
			Meters.
Nemuro	145° 35′ E.	43° 20′ N.	26.7
Miyako	141° 59′ E.	39° 38′ N.	30.4
Isinomaki	141° 19′ E.	38° 26′ N.	44.8

In Table 3:—

x = the barometric gradient at Zikawei for March.
Δx = its departure from the average.
y = the mean air temperature at any locality on [Japan's] east coast for July and August.
Δy = its departure from the average.

TABLE 3.—*Correlation between March barometric gradient at Zikawei and July-August air temperatures in northeastern Japan.*[4]

Station.	Zikawei.	Nemuro.	Zikawei.	Nemuro.	July alone.[5] Nemuro.	
Year.	x	y	Δx	Δy	y	Δy
1891	3.35	15.9	+0.24	+0.5	14.6	0.7
1892	5.00	17.2	+1.89	+1.8	17.1	3.2
1893	2.50	15.2	−0.61	−0.2	13.1	−0.8
1894	3.45	16.6	+0.34	+1.2	15.4	1.5
1895	1.95	14.1	−1.16	−1.3	12.4	−1.5
1896	4.05	15.9	+0.94	+0.5	14.1	0.2
1897	3.75	15.0	+0.64	+0.4	13.0	−0.9
1898	4.35	15.5	+1.24	+0.1	14.5	0.6
1899	2.65	15.0	−0.46	−0.4	14.5	0.6
1900	2.70	15.4	−0.41	0.0	12.5	−1.4
1901	2.20	16.0	−0.91	+0.6	14.1	0.2
1902	0.75	13.3	−2.36	−2.1	12.0	−1.9
1903	2.30	14.8	−0.81	−0.6	13.6	−0.3
1904	3.80	17.4	+0.69	+2.0	16.3	2.4
1905	3.75	14.5	−0.64	−0.9	14.3	0.4
1906	3.05	15.0	−0.06	−0.4	14.3	0.4
1907	3.05	15.3	−0.06	−0.1	13.0	−0.9
1908	3.30	14.5	+0.19	−0.9	11.1	−2.8
1909	3.75	15.7	+0.64	+0.3	14.5	0.6
1910	2.55	14.8	−0.56	−0.6	13.3	−0.6
Mean	3.11	15.4	....	....	13.9	....

These results are graphically shown in the diagram, figure 1.

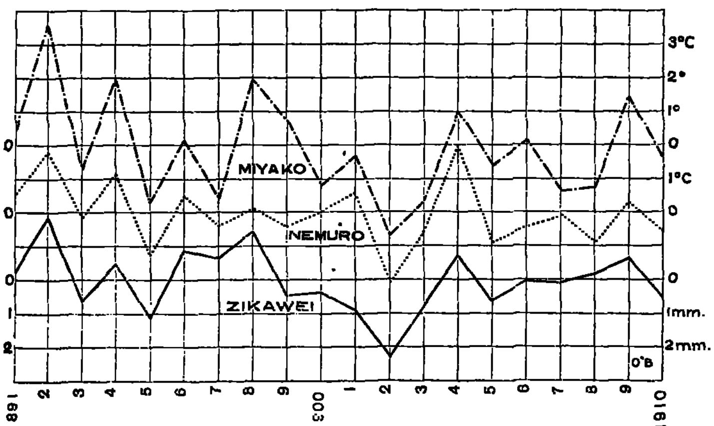

FIG. 1.—Curve of barometric gradient in March at Zikawei (———) compared with temperature departures for the following July at Miyako (—·—·—), and for the following July-August at Nemuro (........).

From an examination of the [complete Table 3] we see that the probabilities of a deviation in the same sense and in an opposite sense are:

TABLE 4.

	Nemuro.	Miyako.	Isinomaki.
Same sense	16	13	15
Opposite sense	3	7	3
Intermediate	1	0	2
Number of cases	20	20	20
Probability of the same sense	80%	65%	75%
Probability (corrected)	87.5%	79.5%	82.5%

We see that the probability of the variation in the same sense is therefore very great. Hence the decline in intensity of the Siberian anticyclone in March appears to be associated with a fall of the mean air temperature on [Japan's] east coast in the following July and August.

[4] Values for Miyako and Isinomaki here omitted.
[5] Added from author's Table V, the remainder of which is omitted—C. A. Jr.

I have also computed the coefficient of correlation, r, and its probable error, w, by the following formula

$$r = \frac{\Sigma(\Delta x.\Delta y)}{\sqrt{\Sigma(\Delta x)^2\ \Sigma(\Delta y)^2}}, \qquad w = \pm 0.6745\,\frac{(1-r^2)}{\sqrt{n}},$$

where n is the number of cases.

The results of the computation are as follows:

TABLE 5.

	Nemuro.	Miyako.	Isinomaki.
$\Sigma(\Delta x)^2$	17.36	17.36	17.36
$\Sigma(\Delta y)^2$	17.89	31.58	29.76
$\Sigma(\Delta x.\Delta y)$	13.32	18.28	15.54
r	+ 0.758	+ 0.781	+ 0.678
w	± 0.065	± 0.059	± 0.081

Hence the smaller the barometric gradient for March on the continent the lower the air temperature in northeastern Japan for July and August.

A similar correlation has been found between the oscillations of the intensity of the action center of the continent in March and the July and August temperatures at other places in Japan, especially in its northeastern provinces; but the correlation is less pronounced on the west side than on the east side of the central mountain ranges.

[Table IV, which is not reprinted, gives the temperature deviation at all stations on either side of the ranges.]

The probability that the sign of the temperature deviation in the different sections of northeastern Japan will be the same as that of the barometric gradient at Zikawei is given in Table 6.

TABLE 6.

Sign.	East side.		West side.					Between the ranges.			
	Abasiri.	Tokyo.	Sapporo.	Suttu.	Akita.	Yamagata.	Niigata.	Kamikawa.	Hakodate.	Aomori.	Hukusima.
Same	16	15	13	12	11	11	13	14	13	14	14
Opposite	2	4	7	5	7	7	6	6	6	6	5
Intermediate	2	1	0	3	2	2	1	0	1	0	1
Cases	20	20	20	20	20	20	20	20	20	20	20
Probability of same sign	80	75	65	60	55	55	65	70	65	70	70

From Table 6 we see that the correlation is fairly established on the east coast and is merely suggestive on the west coast of northeastern Japan.

In northeastern Japan there are two mountain ranges, one of them running along the Pacific coast and the other in the central part of the district. The former is called "Kitakami range" and the latter the "Ō-u range." The flat land between the two ranges is the valley of Kitakami River. The inflowing cool air from the Pacific high is first forced to ascend the steep slope of the Pacific range and descend toward the flat land on the west side of the mountain. Again it ascends the east side of the central range and descends to the coast of the Japan Sea. As the result of pseudo-adiabatic expansion, the cloudiness is increased in these districts, especially on the east sides of the mountains. On the west sides the cooler inflowing air is largely warmed, owing to the adiabatic compression and to conduction from the land surface over which the air flows, and the cloudiness is comparatively less. This explains that [the] correlation under consideration is less pronounced on the western sides of the mountain ranges than on the eastern or Pacific sides.

4. ***Correlation between March barometric gradient at Zikawei and July air temperature on the east coast of Japan.***—In section 3 I have shown that there is a marked correlation between the March pressure gradient at Zikawei and the mean temperature on our east coast for July and August. We shall next examine the correlation between the March gradient at Zikawei and the July temperature at Nemuro and other stations. The last two columns of Table 3 [taken from the author's Table V, which is not reprinted in full] give y and Δy for July alone at Nemuro.

The complete table shows that the probability of a deviation in the same sense is as follows:

TABLE 7.

	Nemuro.	Miyako.	Isinomaki.
Same sense	14	16	15
Opposite sense	6	4	3
Intermediate	0	0	2
Number of cases	20	20	20
Probability in the same sense	70%	80%	75%

The coefficients of correlation and their probable errors are as follows:

TABLE 8.

	Nemuro.	Miyako.	Isinomaki.
$\Sigma(\Delta x)^2$	17.36	17.36	17.36
$\Sigma(\Delta y)^2$	38.59	45.34	43.41
$\Sigma(\Delta x.\Delta y)$	15.77	21.39	16.82
r	+0.609	+0.754	+0.613
w	±0.095	±0.065	±0.094

From the above calculations we see that there is, on the whole, a strongly pronounced resemblance between the intensity of the Siberian anticyclone in March and air temperature on our east coast in the following July.

We give in Table VI [not reprinted] the temperature deviation in July at the other places on either side of the central mountain ranges and shall show that the correlation is most strongly established on our east coast.

Table 9 shows the probability of a July temperature deviation in northeastern Japan, having the same sign as the Zikawei pressure gradient in the preceding March.

TABLE 9.

Sign.	East side.		West side.					Between the ranges.			
	Abasiri.	Tokyo.	Sapporo.	Suttu.	Akita.	Yamagata.	Niigata.	Kamikawa.	Hakodate.	Aomori.	Hukusima.
Same	13	17	13	14	12	15	12	12	14	14	14
Opposite	7	3	6	5	8	5	7	8	4	3	5
Intermediate	0	0	1	1	0	0	1	0	2	3	1
Number of cases	20	20	20	20	20	20	20	20	20	20	20
Probability of the same sign	65	85	65	70	60	75	60	60	70	70	70

5. ***Correlation between barometric gradient at Zikawei for January to March and air temperature on the east coast of Japan in August.***—The following Table 10 shows that there is a suggestive correlation between the barometric gradient x at Zikawei for the period January to March and air temperatures on Japan's east coast in August.

TABLE 10.—*Correlation between barometric gradient at Zikawei for January to March and air temperature on the east coast of Japan* [a] *in August.*

Station.	Zikawei.	Nemuro.	Zikawei.	Nemuro.
Year.	x	y	Δx	Δy
1891	4.4	17.1	+0.3	+0.3
1892	4.9	17.3	+0.8	+0.5
1893	5.1	17.3	+1.0	+0.5
1894	3.6	17.8	−0.5	+1.0
1895	3.3	15.8	−0.8	−1.0
1896	4.2	17.7	+0.1	+0.9
1897	4.6	17.0	+0.5	+0.2
1898	4.1	16.4	0.0	−0.4
1899	3.9	15.4	−0.2	−1.4
1900	4.8	18.2	+0.7	+1.4
1901	4.4	17.9	+0.3	+1.1
1902	2.3	14.5	−1.8	−2.3
1903	3.8	15.9	−0.3	−0.9
1904	3.8	18.5	−0.3	+1.7
1905	3.7	14.7	−0.4	−2.1
1906	4.0	15.7	−0.1	−1.1
1907	4.4	17.5	+0.3	+0.7
1908	4.3	17.8	+0.2	+1.0
1909	4.7	16.8	+0.6	0.0
1910	4.0	16.3	−0.1	−0.5
Mean	....	16.8	....	....

The probabilities of a temperature deviation in the same and the contrary sense with the barometric gradient are:

TABLE 11.

	Nemuro.	Miyako.	Isinomaki.
Same sense	16	13	15
Opposite sense	2	6	4
Intermediate	2	1	1
Number of cases	20	20	20
Probability of the same sense	80%	65%	75%
Probability (corrected)	85%	67.5%	77.5%

The coefficients of correlation and their probable errors are as follows:

TABLE 12.

	Nemuro.	Miyako.	Isinomaki.
$\Sigma(\Delta x)^2$	7.59	7.59	7.59
$\Sigma\Delta y)^2$	25.08	52.87	28.07
$\Sigma(\Delta x.\Delta y)$	8.38	10.07	8.61
r	+0.607	+0.503	+0.590
w	±0.095	±0.113	±0.098

We have also computed the coefficient of correlation between the difference of the barometric pressures at Zikawei and Nafa for January to March, and air temperatures at our east coast stations in August, and have found the following results:

TABLE 13.—*Correlation between the pressure difference Zikawei–Nafa for January to March, and temperatures in August on the east coast of Japan.*

	Nemuro.	Miyako.	Isinomaki.
$\Sigma\Delta x)^2$	8.30	8.30	8.30
$\Sigma(\Delta y)^2$	25.08	52.87	28.07
$\Sigma(\Delta x.\Delta y)$	8.40	10.33	9.09
r	+0.582	+0.493	+0.596
w	±0.010	±0.109	±0.097
Probability, in the same sense	75%	65%	75%

We give in Table VIII [not reprinted] the temperature deviation in August at other places on both sides of the mountain ranges and the deviation of the barometric gra-

[a] Values for Miyako and Isinomaki not reprinted.—C. A. jr.

diation, whence are derived the following probabilities of a temperature deviation of the same sign as the deviation of the pressure gradient.

TABLE 14.

Sign.	East side.		West side.					Between the ranges.			
	Abasiri.	Tokyo.	Sapporo.	Suttu.	Akita.	Yamagata.	Niigata.	Kamikawa.	Hakodate.	Aomori.	Hukusima.
Same	16	13	12	14	12	13	13	13	13	14	11
Opposite	3	6	5	2	6	6	5	5	5	5	6
Intermediate	1	1	3	4	2	1	2	2	2	1	3
No. of cases	20	20	20	20	20	20	20	20	20	20	20
Probability of the same sign (%)	80	65	60	70	60	65	65	65	65	70	55
Probability (corrected) (%)	80.5	65.5	67.5	80.0	70.0	67.5	70.0	70.0	70.0	72.5	62.5

III. DURATION OF BRIGHT SUNSHINE.

5. *Correlation between the barometric gradient at Zikawei for March and the duration of bright sunshine in northeastern Japan in July.*—The anomaly of the duration of bright sunshine at any station is often due to a local cause. Yet I have ventured to examine whether the correlation between sunshine duration and the general barometric distribution exists or not. In the following Table 15 we give the [deviation in] the duration of bright sunshine at the meteorological stations in northeastern Japan. At these stations the bright sunshine is recorded by Jordan's heliograph.

TABLE 15.—*Deviation of sunshine duration (per cent).*

Year.	Barometric gradient, Zikawei.	July.			August.		
		Nemuro.	Tokyo.	Niigata.	Nemuro.	Tokyo.	Niigata.
1891	+0.24	0	− 8	....	0	+ 2	....
1892	+1.89	+ 9	+ 6	+ 6	+ 6	+ 6	+13
1893	−0.61	− 3	+21	+ 7	+ 8	+ 1	+ 7
1894	+0.34	+ 5	+22	+ 8	0	+ 8	+18
1895	−1.16	+ 7	−11	+ 8	− 1	− 3	0
1896	+0.94	+ 4	+ 1	+ 7	+ 1	+ 3	− 9
1897	+0.64	+ 7	− 4	−18	+11	−10	−13
1898	+1.24	0	+30	+ 4	+ 4	+ 1	+30
1899	−0.46	−10	− 9	−17	− 8	+ 7	− 2
1900	−0.41	+ 6	− 8	+12	+ 1	+15	− 5
1901	−0.91	− 1	−11	+ 1	− 5	+ 5	−10
1902	−2.36	− 5	− 9	−22	− 6	−20	−20
1903	−0.81	− 2	− 4	0	+ 8	+12	−29
1904	+0.69	+ 3	+ 9	+18	+ 7	+15	− 7
1905	−0.64	+ 5	− 4	−26	− 3	−23	+ 3
1906	−0.06	− 9	− 9	− 3	+ 1	− 7	+ 2
1907	+0.06	0	+ 3	+ 4	−15	− 3	+18
1908	+0.19	−10	− 6	+19	+ 4	+ 5	+ 2
1909	+0.64	+ 1	+ 6	+10	− 4	+ 1	+11
1910	−0.56	−12	−14	−11	−10	−17	− 3
Mean	....	32	39	52	33	50	43

The probabilities of a sunshine deviation of the same sign in July and in August, and the coefficients of correlation are shown in Table 16.

TABLE 16.

Sign.	July.			August.		
	Nemuro.	Tokyo.	Niigata.	Nemuro.	Tokyo.	Niigata.
Same	13	15	13	13	14	11
Opposite	4	5	5	5	6	7
Intermediate	3	0	1	1	0	1
Number of cases	20	20	19	20	20	19
Probability	65	75	68	65	70	63
Correlation coefficient	0.37	0.58	0.47	0.41	0.42	0.47
Probable error	±0.13	±0.10	±0.12	±0.13	±0.12	±0.12

From Table 16 we see that on the east coast of northeastern Japan the correlation between the variation of the intensity of the action center in March and duration of bright sunshine is at least a suggestive one. The greater the barometric gradient at Zikawei for March the greater the duration of bright sunshine on our east coast in July and August. But on the west side of the central mountain range in northeastern Japan we could not find any correlation which is worthy of notice. This fact gives a hint for the physical interpretation of this correlation between temperature and barometric oscillations, which will be given in my Second Note.

ANNUAL HOURS OF FOG, 1885–1915.[1]

A compilation of approximate hours of fog or thick weather observed per year at 508 fog-signal stations throughout the [Lighthouse] Service during the period 1885 to 1915, inclusive, has been continued from the records of the Lighthouse Service, along the lines mentioned in the Bulletin for August, 1912. A summary of the principal results is given in Table 1, giving the results for the station in each district having the maximum number of hours of fog in a single year and the station having the highest annual average for the period.

TABLE 1.—*Hours of fog or thick weather, per year, at 508 stations, 1885—1915.*

District.	Number of stations[1]	Mean hours per year for district.[2]	Maximum observed.			Highest annual average.		
			Station.	Hrs.	Year.	Station.	Hrs.	Yrs.
1st	56	874	Seguin	2,734	1907	Petit Manan	1,691	31
2d	36	680	Great Round Shoal L. Vessel.	1,727	1907	Pollock Rip Slue L. Vessel.	1,175	14
3d	100	463	New London Harbor.	1,809	1885	Block Island S. E.	831	31
4th	12	363	Delaware Breakwater.	912	1887	Delaware Breakwater.	525	30
5th	85	218	Cape Henry	902	1904	Baltimore	426	7
6th	7	135	Martins Industry L. V.	320	1898	Brunswick L. V.	183	8
7th	1	112	Egmont Key	128	1913	Egmont Key	112	3
8th	16	281	Cubits Gap	819	1907	Cubits Gap	562	10
10th	15	228	Cleveland Breakwater.	1,224	1915	Buffalo Breakwater.	524	22
11th	47	310	Thunder Bay Island.	1,085	1909	Middle Island	541	11
12th	54	359	Calumet Harbor	2,269	1913	Calumet Harbor	1,196	9
16th	10	278	Scotch Cap	1,144	1915	Cape Hinchinbrook	555	5
17th	29	439	Swiftsure Bank L. V.	1,770	1912	Swiftsure Bank L. V.	1,203	9
18th	40	606	San Francisco L.V.	2,145	1915	Point Reyes	1,337	31

[1] No fog-signal stations in the 9th, 13th, 14th, 15th, and 19th districts. No regular station in the 7th district prior to 1913.

[2] Compiled from the station averages instead of from the annual district averages, as was the case in previous report.

The absolute maximum record at Seguin, Me., of 2,734 hours in 1907, equivalent to about 30 per cent of the entire year (8,760 hours) has not been exceeded. The highest annual average record remains at Petit Manan, Me., being 1,691 hours per year for 31 years, or over 19 per cent of the period. Out of 29 stations in the entire Service averaging over 1,000 hours of fog per year, 14 or practically half are in the first district.

An interesting maximum record is that observed at Calumet Harbor, near Chicago, Ill., in the twelfth district, where 2,269 hours of fog, or about 26 per cent of the year, occurred in 1913. This and other Lake stations are affected somewhat by smoke in the vicinity.

[1] *Reprinted from* Lighthouse Service Bulletin, December, 1915, No. 48, p. 194.